

## PATENT ABSTRACTS OF JAPAN

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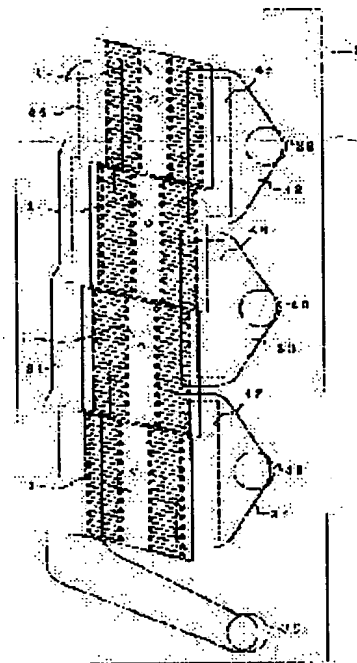
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## (54) INK JET RECORDING HEAD

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To achieve a recording head having multiple nozzles capable of performing highly accurate printing by disposing a plurality of actuators with the smallest dead space.

**SOLUTION:** This recording head comprises actuator units 1, 1 each having a plurality of pressure generating chambers which are arranged in a paper conveying direction in two lines in the carriage moving direction and pressure generating means each pressurizing the respective pressure generating chambers and a fluid passage forming unit 2 having a reservoir 31 communicated to the pressure generating chambers arranged on one line and a plurality of reservoirs 32-34 respectively communicated to pressure generating chambers arranged on the other line which are divided into plural regions in the paper conveying direction. The actuator units are disposed with the smallest dead space. A line of nozzle openings for ejecting black ink capable of performing data processing in a comparatively high speed are arranged without varying the pitches thereof. A line of nozzle openings of which speed of data processing becomes slow compared to the openings for black ink are arranged on the same line of the nozzle openings for black ink in the main scanning direction with high accuracy.



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**CLAIMS**


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**[Claim(s)]**

[Claim 1] The ink-jet formula recording head which is characterized by providing the following and which consists of a passage unit Two or more pressure generating rooms which were located in a line in the direction of an ejection, and were formed in the move direction of carriage two trains The reservoir which divides the pressure generating room which arranges two or more actuator units equipped with a pressure generating means to pressurize each aforementioned pressure generating room, in the direction of an ejection, and is located in a line with one [ at least ] train in the aforementioned ejection direction to two or more fields, and is open for free passage Nozzle opening which is open for free passage in each aforementioned pressure generating room

[Claim 2] a reservoir common to the pressure generating room on a par with aforementioned one train. — moreover, the ink-jet formula recording head according to claim 1 which the division reservoir which the pressure generating room on a par with the train of aforementioned another side was divided in the aforementioned ejection direction to two or more fields, and resembled the pressure generating room of each field, respectively, and became independent in it opens for free passage

[Claim 3] The ink-jet formula recording head according to claim 2 by which the ink of black is supplied to a reservoir common to the above, and color ink is supplied to the aforementioned division reservoir.

[Claim 4] The ink-jet formula recording head according to claim 1 by which the nozzle opening train of the two aforementioned train is arranged so that it may be located in the aforementioned ejection direction on the same line .

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[The field of the technology in which invention belongs] this invention relates to plurality, the ink-jet formula recording head which carried out column arrangement, and the ink-jet formula recording head for full color printing which constituted the actuator unit of the pressure generating room which is open for free passage to nozzle opening which a pressure generating means is prepared [ unit ] in a field in part, and the ink of a pressure generating room is pressurized [ unit ], and generates an ink drop combining two or more [ more ] actuator [ detail ] unit.

[0002]

[Description of the Prior Art] Since it corresponds to high-speed printing and high-speed high-density printing, although increasing the number of nozzle openings per recording head is performed in order to influence an ink-jet formula recording head sensitively of unevenness, such as a flow resistance of passage, such as nozzle opening and a pressure generating room, on the relation treating a liquid called ink, forming many nozzle openings and pressure generating rooms in homogeneity and a high precision, since a quality of printed character deteriorates extremely and stops making the business as a recording head, when things are required and fault moreover occurs in at least one of passage or the pressure generating means. The yield of the manufacture has the problem of a low extremely.

[0003] In order to solve such a problem, constituting the recording head which arranged two or more recording heads with comparatively few pressure generating means in main scanning direction as a unit, and was equipped with much nozzle openings is performed. According to this, the yield of a part with few pressure generating means is to constitute one unit of manufacture as a unit can improve, and the recording head which has much nozzle openings as a result can be manufactured by the high yield.

[0004]

[Problem(s) to be Solved by the Invention] However, since enlargement of a recording device is caused and gross errors arise in the dot formation position between nozzle opening for blacks which influences a quality of printed character greatly also with the minute inclination at the time of the size as a recording head becoming large, consequently attaching a recording head in a recording device since a gap is generated between each actuator unit, and nozzle opening for colors, there is a problem that attachment work becomes difficult. The place which this invention is made in view of such a problem, and is made into the purpose is especially small using two or more record actuator units, and is offering the ink-jet formula recording head which can maintain the position precision of nozzle opening.

[0005]

[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. Two or more pressure generating rooms which were located in a line in the direction of an ejection, and were formed in the move direction of carriage two trains. The reservoir which divides the pressure generating room which arranges two or more actuator units equipped with a pressure generating means to pressurize each aforementioned pressure generating room, in the direction of an ejection, and is located in a line with one [ at least ] train in the aforementioned ejection direction to two or more fields, and is open for free passage. It had the passage unit equipped with nozzle opening which is open for free passage in each aforementioned pressure generating room.

[0006]

[Function] Since two or more actuator units are arranged in the direction of an ejection and the reservoir is divided in the direction of an ejection at plurality, considering nozzle numerical aperture, the size of the main scanning direction of a recording head becomes small, and a recording device is miniaturized. moreover, the \*\*\*\* generating room which breathes out different ink — the same unit — formation \*\*\*\* — the nozzle opening train of color ink \*\*\*\* from which data processing serves as a low speed as compared with black in the number of black ink \*\*\*\* nozzle opening trains which can maintain a high position precision and can perform data processing comparatively at high speed, without disturbing a nozzle opening array pitch is located on the same line of main scanning direction in nozzle opening of black, and a precision high to the same extent.

[0007]

[Embodiments of the Invention] Then, based on the example illustrating the detail of this invention, it explains below. Drawing 1 shows an example of this invention, and the signs 1, 1, 1, and 1 in drawing are being fixed to the passage formation unit 2 which can shift fixed distance d later mutually and motions later four actuator units which pressurize the ink constituted as the same structure mutually.

[0008] The array structure of the pressure generating room currently formed in the actuator unit to which an actuator unit and a passage formation unit are separated and shown, and drawing 3 mentioned them above in the cross-section structure of the axis of a pressure generating room where drawing 2 counters is shown.

[0009] To the substrate which consists of ceramic boards, such as a zirconia ( $ZrO_2$ ) with the thickness which the sign 10 in drawing is a spacer and constitutes the pressure generating rooms 11 and 12 with a depth of about 150 micrometers, and for which it was suitable the thing. The axis of the longitudinal direction serves as [the pressure generating rooms 11 and 12] an acute angle  $\theta$  to the array directional traverse of the nozzle openings 42 and 43. And it is arranged so that the nose of cam of the inside which counters may be located on the same line of main scanning direction, i.e., the move direction of carriage, and by the ability shifting the \*\*\*\* timing of an ink drop, it is constituted so that formation of a dot may be almost possible in the same position.

[0010] Moreover, the up-and-down outer walls 1a and 1b are formed so that it may become almost parallel to the axis of the pressure generating rooms 11 and 12, and the thickness is constituted thinly as much as possible.

[0011] Thus, when it can constitute for a long time and width of face of a pressure generating room must be made small especially by densification as compared with the conventional pressure generating room arranged right-angled by making the pressure generating rooms 11 and 12 incline so that the direction of an axis may serve as an acute angle  $\theta$  to the array line of nozzle opening, and arranging them, even if it is, the capacity of a pressure generating room required for making an ink drop breathe out is fully securable.

[0012] A sign 13 is an elastic plate, and it consists of a piezo-electric oscillating object 14 mentioned later and material of 15 .... which carries out elastic deformation by flexural oscillation, for example, the sheet metal of a zirconia with a thickness of 7 micrometers, while it demonstrates sufficient junction force, when it calcinates to a spacer 10 and one.

[0013] It is the above-mentioned piezo-electric oscillating object, and 14 and 15 .... make the green sheet of piezoelectric material counter each pressure generating rooms 11 and 12, are stuck on the front face of the lower electrodes 16 and 17 currently formed in the front face of an elastic plate 13, are sintered after that, further, they fix the upper electrodes 18 and 19 and are constituted by the front face, respectively.

[0014] These each part material 10 and 13 is fixed to one by baking, and the above-mentioned actuator unit 1 is constituted.

[0015] On the other hand, the sign 2 in drawing is the above-mentioned passage formation unit which serves as the fixed substrate of these actuator unit 1, carries out the laminating of the nozzle plate 22 to the ink feed-hopper formation substrate 20 to which the actuator unit 1 serves as the cover plate stuck and fixed, and the reservoir formation substrate 21, and is constituted so that the effective area of another side of a spacer 10 may be closed.

[0016] The through-holes 23 and 24 which the ink feeder current way formation substrate 20 consists of sheet metal of a zirconia with a thickness of 100 micrometers, and connect the nozzle openings 42 and 43 and the pressure generating rooms 11 and 12 of a nozzle plate 22. The ink feed hoppers 25 and 26 equipped with the flow resistance which is the grade which the reservoirs 31 and 32 (33 34) and the pressure generating rooms 11 and 12 which are mentioned later can be connected [grade], and can make an ink drop breathe out are drilled, and it is constituted. Moreover, four ink inlets 38-41 are formed in the position distant from reservoirs 31 and 32 (33 34) in the fixed pitch so that it may stand in a line on the same line of the unilateral of the actuator unit 1.

[0017] The reservoir 31 which supplies ink to the whole pressure generating room arranged at an unilateral at the plate suitable for the reservoir formation substrate 21 constituting reservoirs 31 and 32 (33 34) equipped with corrosion resistance, such as 150-micrometer stainless steel, for example, the nozzle free passage which connects each pressure generating rooms 11 and 12 and the nozzle openings 42 and 43 while forming three reservoirs 32 (33 34) which supply ink independently to the pressure generating room 12 located in a side besides each actuator unit — holes 27 and 28 are formed and it is constituted

[0018] The reservoirs 32-34 formed in the side else are formed in the ink feed hopper 26 which is open for free passage in 13 pressure generating rooms 12, and the size which can be open for free passage in the number which divided two or more pressure generating rooms 12 up and down on a par with a side besides four actuator units 1, 1, 1, and 1, respectively into three equally, and this example. Moreover, the ink inlets 38, 39, 40, and 41 formed in the ink feed-hopper formation substrate 20 are open for free passage, and supply of a yellow, a Magenta, and the ink of cyanogen of each reservoirs 31-34 is attained at the reservoir 31 at black ink and other reservoirs 32-34.

[0019] 22 is the above-mentioned nozzle plate and was shown in drawing 5 — as — the actuator units 1, 1, 1, and 1 — a nozzle free passage — it is open for free passage through holes 23 and 27, and 24 and 28, and it is formed in the same pitch as the above-mentioned pressure generating rooms 11 and 12 so that two things horizontally located in a line may be located on the same line. In addition, the signs 44-47 in drawing show the compliance grant field which consists of a thin-walled part formed in each reservoirs 31-34.

[0020] In this example, it carries in carriage so that the array line of each nozzle openings 42 and 43 may be in agreement in the direction of vertical scanning of an ejection, i.e., the direction, and the ink of black is supplied to the reservoir 31 of the unilateral of the passage formation unit 2, and each ink of a yellow, cyanogen, and a Magenta is supplied to three reservoirs 32, 33, and 34 of the side else. And the dot formation signal of black is supplied to the piezoelectric transducer 14 of the unilateral of each units 1, 1, 1, and 1, and a color dot formation signal is supplied to the piezoelectric transducer 15 of a side of each unit.

[0021] That is, the dot formation signal of cyanogen is further supplied to the piezoelectric transducer 15 of the pressure generating room 12 which is open for free passage to a reservoir 34 at the piezoelectric transducer 15 of the pressure generating room 12 which the dot formation signal of a Magenta opens for free passage to a reservoir

33 again at the piezoelectric transducer 15 of the pressurizing room 12 which a yellow dot formation signal opens for free passage to a reservoir 32.

[0022] Therefore, if a black dot formation signal is impressed, a piezoelectric transducer 14 will bend and displace to a pressurizing room side, and will pressurize the ink of the pressure generating room 11 of an unilateral. the pressurized black ink — the nozzle free passage of the passage formation unit 2 — \*\* breathed out as an ink drop from the nozzle opening 42 via holes 23 and 27

[0023] If a driving signal is severed and a piezoelectric transducer 14 returns to the original state, the pressurizing room 11 will expand. Ink flows into the pressure generating room 11 from the reservoir 31 which this connects through the pressure generating room 11 and the ink feed hopper 25 concerned.

[0024] Moreover, if the dot formation signal of a color is impressed, the piezoelectric transducer 15 of the side else will bend and displace to a pressure generating room side, and will pressurize the ink of the pressure generating room 12 of the side else. the ink of the pressurized color — the nozzle free passage of the passage formation unit 2 — \*\* breathed out as an ink drop from the nozzle opening 43 via holes 24 and 28

[0025] If a driving signal is severed and a piezoelectric transducer 15 returns to the original state, the pressure generating room 12 will expand. The color ink of the reservoirs 32-34 which this connects through the pressure generating room 12 and the ink feed hopper 26 concerned flows into the pressure generating room 12.

[0026] By the way, since the position is shifted in the direction of an ejection every about 13 dots, the \*\* nozzle opening 43 which breathes out the ink drop of a color can form the dot of each color in the same position by making the feed per revolution of a record form in agreement with the recording width of each color. Hereafter, such a process is repeated and printing is performed.

[0027] On the other hand, if it supplies a driving signal only to the piezoelectric transducer 14 of the pressure generating room 11 arranged up and down by the unilateral in printing text data and monochrome image data, it can print to the width of face of about about 3 times [ at the time of color printing ] direction of an ejection.

[0028] In addition, although the example was taken and explained when a recording head was constituted using four actuator units in this example Also as opposed to that in which very many number of pressure generating rooms was formed, and the thing using two or more actuators again It is clear to divide the thing from an unilateral into black, and to divide the thing by the side of the side else into two or more fields, and to do the same operation so, if it is the structure which can supply ink independently to each field.

[0029] Drawing 6 is what shows other examples of this invention. the signs 1, 1, and 1 in drawing Three actuator units which pressurize the ink constituted as the same structure It is arranged in the direction of an ejection at the passage unit 50 which carries out the fixed \*\*\*\*\* after-mentioned so that it may be located on the same line in the direction of an ejection at one side of the train of the pressure generating room of other units where the train of one pressure generating room adjoins among the trains of the pressure generating room of two trains of each unit 1 desirably.

[0030] It is formed in the passage unit 50 so that it may be located on the same line in the direction of an ejection at one side of the nozzle opening train which is open for free passage to other units which one nozzle opening train adjoins among the nozzle opening trains of two trains which the pressure generating room of each actuator unit and nozzle opening open for free passage open for free passage to each unit 1 desirably. Moreover, the ink inlets 51, 52, 53, 54, 55, and 56 are formed so that it may be located in the both sides of each actuator units 1, 1, and 1, and the reservoirs 57, 58, 59, 60, 61, and 62 which each ink inlets 51-56 are made open for free passage, and are open for free passage in each actuator units 1 and 1 and the pressure generating room in every one are formed.

[0031] According to this example, by supplying the ink of the ink in which colors differ, i.e., black, a yellow, a dark Magenta, a light Magenta, dark cyanogen, and light cyanogen from the outside to each ink inlets 51-56, it can stop and the recording device in which color printing in the ink of six colors is possible can be constituted, as long as possible in the size of main scanning direction.

[0032] In addition, although the example was taken and explained when three actuator units were used in this example, the recording head which makes the ink drop of six or more colors breathe out can be constituted by increasing further the number of the actuator units arranged in the direction of an ejection.

[0033] In addition, it sets in the above-mentioned example, and although the example was taken and explained to the recording head which used two or more units which it expands [ units ] and shrink a pressure generating room by flexural oscillation of a piezoelectric transducer, the same operation is done so, even if it makes the end of the piezoelectric transducer in longitudinal-oscillation mode contact an elastic plate and applies to what heats a pressure generating room by the heater element, and pressurizes it.

[0034] Moreover, although the example was taken and explained to the actuator which made the pressure generating room incline to the array line of nozzle opening in an above-mentioned example, it is clear that the array pitch of nozzle opening in an adjoining field is applicable also to the thing of structure maintainable identically to the array pitch of nozzle opening of actuator unit original.

[0035]

[Effect of the Invention] Two or more pressure generating rooms which were located in a line in the direction of an ejection in this invention as explained above, and were formed in the moving direction of carriage two trains. The reservoir which divides the pressurizing room which arranges two or more actuator units equipped with a pressurizing means to pressurize each pressure generating room, in the direction of an ejection, and is located in a line with one [ at least ] train in the direction of an ejection to two or more fields, and is open for free passage. Since the passage unit equipped with nozzle opening which is open for free passage in each pressurizing

generating room constituted the recording head. The small recording head which has arranged two or more actuator units by the small dead space as much as possible, and improved the precision of a dot formation position, and was excellent in the quality of printed character is realizable.

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**TECHNICAL FIELD**

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[The field of the technology in which invention belongs] this invention relates to plurality, the ink-jet formula recording head which carried out column arrangement, and the ink-jet formula recording head for full color printing which constituted the actuator unit of the pressure generating room which is open for free passage to nozzle opening which a pressure generating means is prepared [ unit ] in a field in part, and the ink of a pressure generating room is pressurized [ unit ], and generates an ink drop combining two or more [ more ] actuator [ detail ] unit.

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**PRIOR ART**

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[Description of the Prior Art] Since it corresponds to high-speed printing and high-speed high-density printing, although increasing the number of nozzle openings per recording head is performed, it is an ink-jet formula recording head. In order to be sensitively influenced of unevenness, such as a flow resistance of passage, such as nozzle opening and a pressure generating room, on the relation treating a liquid called ink, forming many nozzle openings and pressure generating rooms in homogeneity and a high precision, since a quality of printed character deteriorates extremely and stops making the business as a recording head, when things are required and fault moreover occurs in at least one of passage or the pressure generating meanses The yield of the manufacture has the problem of a low extremely.

[0003] In order to solve such a problem, constituting the recording head which arranged two or more recording heads with comparatively few pressure generating meanses in main scanning direction as a unit, and was equipped with much nozzle openings is performed. According to this, the yield of a part with few pressure generating meanses to constitute one unit of manufacture as a unit can improve, and the recording head which has much nozzle openings as a result can be manufactured by the high yield.

[0004]

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] Two or more pressure generating rooms which were located in a line in the direction of an ejection in this invention as explained above, and were formed in the move direction of carriage two trains, The reservoir which divides the pressure generating room which arranges two or more actuator units equipped with a pressure generating means to pressurize each pressure generating room, in the direction of an ejection, and is located in a line with one [ at least ] train in the direction of an ejection to two or more fields, and is open for free passage, The passage unit equipped with nozzle opening which is open for free passage in each pressure generating room constituted the recording head. Therefore, the small recording head which has arranged two or more actuator units by the small dead space as much as possible, and improved the precision of a dot formation position, and was excellent in the quality of printed character is realizable.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] However, since enlargement of a recording device is caused and gross errors arise in the dot formation position between nozzle opening for blacks which influences a quality of printed character greatly also with the minute inclination at the time of the size as a recording head becoming large, consequently attaching a recording head in a recording device since a gap is generated between each actuator unit, and nozzle opening for colors, there is a problem that attachment work becomes difficult. The place which this invention is made in view of such a problem, and is made into the purpose is especially small using two or more record actuator units, and is offering the ink-jet formula recording head which can maintain the position precision of nozzle opening.

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**MEANS**

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[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. Two or more pressure generating rooms which were located in a line in the direction of an ejection, and were formed in the move direction of carriage two trains, The reservoir which divides the pressure generating room which arranges two or more actuator units equipped with a pressure generating means to pressurize each aforementioned pressure generating room, in the direction of an ejection, and is located in a line with one [ at least ] train in the aforementioned ejection direction to two or more fields, and is open for free passage, It had the passage unit equipped with nozzle opening which is open for free passage in each aforementioned pressure generating room.

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## OPERATION

[Function] Since two or more actuator units are arranged in the direction of an ejection and the reservoir is divided in the direction of an ejection at plurality, considering nozzle numerical aperture, the size of the main scanning direction of a recording head becomes small, and a recording device is miniaturized. moreover, the pressure generating room which carries out the regurgitation of the different ink — the same unit — formation \*\*\*\*\* — the nozzle opening train for color ink regurgitation from which data processing serves as a low speed as compared with black in the number for black ink regurgitation of nozzle opening trains which can maintain a high position precision and can perform data processing comparatively at high speed, without disturbing a nozzle opening array pitch is located on the same line of main scanning direction in nozzle opening of black, and a precision high to the same extent

[0007]

[Embodiments of the Invention] Then, based on the example illustrating the detail of this invention, it explains below. Drawing 1 shows one example of this invention, and the signs 1, 1, 1, and 1 in drawing are being fixed to the passage formation unit 2 which can shift fixed distance  $\Delta L$  mutually and mentions later four actuator units which pressurize the ink constituted as the same structure mutually.

[0008] The array structure of the pressure generating room currently formed in the actuator unit to which an actuator unit and a passage formation unit are separated and shown, and drawing 3 mentioned them above in the cross-section structure of the axis of a pressure generating room where drawing 2 counters is shown.

[0009] To the substrate which consists of ceramic boards, such as a zirconia ( $ZrO_2$ ) with the thickness which the sign 10 in drawing is a spacer and constitutes the pressure generating rooms 11 and 12 with a depth of about 150 micrometers, and for which it was suitable the thing The axis of the longitudinal direction serves as [ the pressure generating rooms 11 and 12 ] an acute angle  $\theta$  to the array directional traverse of the nozzle openings 42 and 43. And it is arranged so that the nose of cam of the inside which counters may be located on the same line of main scanning direction, i.e., the move direction of carriage, and by the ability shifting the regurgitation timing of an ink drop, it is constituted so that formation of a dot may be almost possible in the same position.

[0010] Moreover, the up-and-down outer walls 1a and 1b are formed so that it may become almost parallel to the axis of the pressure generating rooms 11 and 12, and the thickness is constituted thinly as much as possible.

[0011] Thus, when it can constitute for a long time and width of face of a pressure generating room must be made small especially by densification as compared with the conventional pressure generating room arranged right-angled by making the pressure generating rooms 11 and 12 incline so that the direction of an axis may serve as an acute angle  $\theta$  to the array line of nozzle opening, and arranging them, even if it is, the capacity of a pressure generating room required for making an ink drop breathe out is fully securable.

[0012] A sign 13 is an elastic plate, and it consists of a piezo-electric oscillating object 14 mentioned later and material of 15 .... which carries out elastic deformation by flexural oscillation, for example, the sheet metal of a zirconia with a thickness of 7 micrometers, while it demonstrates sufficient junction force, when it calcinates to a spacer 10 and one.

[0013] It is the above-mentioned piezo-electric oscillating object, and 14 and 15 .... make the green sheet of piezoelectric material counter each pressure generating rooms 11 and 12, are stuck on the front face of the lower electrodes 16 and 17 currently formed in the front face of an elastic plate 13, are sintered after that, further, they fix the upper electrodes 18 and 19 and are constituted by the front face, respectively.

[0014] These each part material 10 and 13 is fixed to one by baking, and the above-mentioned actuator unit 1 is constituted.

[0015] On the other hand, the sign 2 in drawing is the above-mentioned passage formation unit which serves as the fixed substrate of these actuator unit 1, carries out the laminating of the nozzle plate 22 to the ink feed-hopper formation substrate 20 to which the actuator unit 1 serves as the cover plate stuck and fixed, and the reservoir formation substrate 21, and is constituted so that the effective area of another side of a spacer 10 may be closed.

[0016] The through-holes 23 and 24 which the ink feed current way formation substrate 20 consists of sheet metal of a zirconia with a thickness of 100 micrometers, and connect the nozzle openings 42 and 43 and the pressure generating rooms 11 and 12 of a nozzle plate 22. The ink feed hoppers 25 and 26 equipped with the flow resistance which is the grade which the reservoirs 31 and 32 (33 34) and the pressure generating rooms 11 and 12 which are mentioned later can be connected [ grade ], and can make an ink drop breathe out are drilled, and it is constituted. Moreover, four ink inlets 38-41 are formed in the position distant from reservoirs 31 and 32 (33 34) in the fixed pitch  $s$  that it may stand in a line on the same line of the unilateral of the actuator unit 1.

[0017] The reservoir 31 which supplies ink to the whole pressurizing room arranged at an unilateral at the plate suitable for the reservoir formation substrate 21 constituting reservoirs 31 and 32 (33 34) equipped with corrosion resistance, such as 150-micrometer stainless steel, for example, the nozzle free passage which connects each pressure generating rooms 11 and 12 and the nozzle openings 42 and 43 while forming the reservoirs 32 (33 34) which supply ink independently to the pressure generating room 12 located in a side besides each actuator unit — holes 27 and 28 are formed and it is constituted.

[0018] The reservoirs 32-34 formed in the side else are formed in the ink feed hopper 26 which is open for free passage in 13 pressure generating rooms 12, and the size which can be open for free passage in the number which divided two or more pressure generating rooms 12 up and down on a par with a side besides four actuator units 1, 1, 1, and 1, respectively into three equally, and this example. Moreover, the ink inlets 38, 39, 40, and 41 formed in the ink feed-hopper formation substrate 20 are open for free passage, and supply of a yellow, a Magenta, and the ink of cyanogen of each reservoirs 31-34 is attained at the reservoir 31 at black ink and other reservoirs 32-34.

[0019] 22 is the above-mentioned nozzle plate and was shown in drawing 5 — as — the actuator units 1, 1, 1, and 1 — a nozzle free passage — it is open for free passage through holes 23 and 27, and 24 and 28, and it is formed in the same pitch as the above-mentioned pressure generating rooms 11 and 12 so that two things horizontally located in a line may be located on the same line. In addition, the signs 44-47 in drawing show the compliance grant field which consists of a thin-walled part formed in each reservoirs 31-34.

[0020] In this example, it carries in carriage so that the array line of each nozzle openings 42 and 43 may be in agreement in the direction of vertical scanning of an ejection, i.e., the direction, and the ink of black is supplied to the reservoir 31 of the unilateral of the passage formation unit 2, and each ink of a yellow, cyanogen, and a Magenta is supplied to three reservoirs 32, 33, and 34 of the side else. And the dot formation signal of black is supplied to the piezoelectric transducer 14 of the unilateral of each units 1, 1, 1, and 1, and a color dot formation signal is supplied to the piezoelectric transducer 15 of a side besides each unit.

[0021] That is, the dot formation signal of cyanogen is further supplied to the piezoelectric transducer 15 of the pressure generating room 12 which is open for free passage to a reservoir 34 at the piezoelectric transducer 15 of the pressure generating room 12 which the dot formation signal of a Magenta opens for free passage to a reservoir 33 again at the piezoelectric transducer 15 of the pressure generating room 12 which a yellow dot formation signal opens for free passage to a reservoir 32.

[0022] Thereby, if a black dot formation signal is impressed, a piezoelectric transducer 14 will bend and displace to a pressure generating room side, and will pressurize the ink of the pressure generating room 11 of an unilateral. the pressurized black ink — the nozzle free passage of the passage formation unit 2 — the regurgitation is carried out as an ink drop from the nozzle opening 42 via holes 23 and 27.

[0023] If a driving signal is severed and a piezoelectric transducer 14 returns to the original state, the pressure generating room 11 will expand. Ink flows into the pressure generating room 11 from the reservoir 31 which this connects through the pressure generating room 11 and the ink feed hopper 25 concerned.

[0024] Moreover, if the dot formation signal of a color is impressed, the piezoelectric transducer 15 of the side else will bend and displace to a pressure generating room side, and will pressurize the ink of the pressure generating room 12 of the side else. the ink of the pressurized color — the nozzle free passage of the passage formation unit 2 — the regurgitation is carried out as an ink drop from the nozzle opening 43 via holes 24 and 28.

[0025] If a driving signal is severed and a piezoelectric transducer 15 returns to the original state, the pressure generating room 12 will expand. The color ink of the reservoirs 32-34 which this connects through the pressure generating room 12 and the ink feed hopper 26 concerned flows into the pressure generating room 12.

[0026] By the way, since the position is shifted in the direction of an ejection every about 13 dots, the nozzle opening 43 which carries out the regurgitation of the ink drop of a color can form the dot of each color in the same position by making the feed per revolution of a record form in agreement with the recording width of each color. Hereafter, such a process is repeated and printing is performed.

[0027] On the other hand, if it supplies a driving signal only to the piezoelectric transducer 14 of the pressure generating room 11 arranged up and down by the unilateral in printing text data and monochrome image data, it can print to the width of face of about about 3 times [ at the time of color printing ] direction of an ejection.

[0028] In addition, although the example was taken and explained when a recording head was constituted using four actuator units in this example. Also as opposed to that in which very many number of pressure generating rooms was formed, and the thing using two or more actuators again. It is clear to divide the thing from an unilateral into black, and to divide the thing by the side of the side else into two or more fields, and to do the same operation so, if it is the structure which can supply ink independently to each field.

[0029] Drawing 6 is what shows other examples of this invention. the signs 1, 1, and 1 in drawing Three actuator units which pressurize the ink constituted as the same structure. It is arranged in the direction of an ejection at the passage unit 50 which carries out the fixed \*\*\*\*\* after-mentioned so that it may be located on the same line in the direction of an ejection at one side of the train of the pressurizing room of other units where the train of one pressurizing room adjoins among the trains of the pressurizing room of two trains for each unit 1 desirably.

[0030] It is formed in the passage unit 50 so that it may be located on the same line in the direction of an ejection at one side of the nozzle opening train which is open for free passage to other units which the nozzle opening train adjoins among the nozzle opening trains of two trains which the pressurizing room of each actuator unit and nozzle opening open for free passage open for free passage to each unit 1 desirably. Moreover, the ink inlets 51, 52,

53, 54, 55, and 56 are formed so that it may be located in the both sides of each actuator units 1, 1, and 1, and the reservoirs 57, 58, 59, 60, 61, and 62 which each ink inlets 51-56 are made open for free passage, and are open for free passage in each actuator units 1 and 1 and the pressure generating room in every one are formed.

[0031] According to this example, by supplying the ink of the ink in which colors differ, i.e., black, a yellow, a dark Magenta, a light Magenta, dark cyanogen, and light cyanogen from the outside to each ink inlets 51-56, it can stop and the recording device in which color printing in the ink of six colors is possible can be constituted, as long as possible in the size of main scanning direction.

[0032] In addition, although the example was taken and explained when three actuator units were used in this example, the recording head which makes the ink drop of six or more colors breathe out can be constituted by increasing further the number of the actuator units arranged in the direction of an ejection.

[0033] In addition, it sets in the above-mentioned example, and although the example was taken and explained to the recording head which used two or more units which it expands [units] and shrink a pressure generating room by flexural oscillation of a piezoelectric transducer, the same operation is done so, even if it makes the end of the piezoelectric transducer in longitudinal-oscillation mode contact an elastic plate and applies to what heats a pressure generating room by the heater element, and pressurizes it.

[0034] Moreover, although the example was taken and explained to the actuator which made the pressure generating room incline to the array line of nozzle opening in an above-mentioned example, it is clear that the array pitch of nozzle opening in an adjoining field is applicable also to the thing of structure maintainable identically to the array pitch of nozzle opening of actuator unit original.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

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## [Brief Description of the Drawings]

[Drawing 1] It is the front view showing one example of the recording head of this invention.

[Drawing 2] It is drawing in which dividing an actuator unit and a passage formation unit into, and showing the cross-section structure of the axis of the pressure generating room which counters an ink-jet formula recording head same as the above.

[Drawing 3] It is drawing in which removing an elastic plate and showing one example of the actuator unit which constitutes the ink-jet formula recording head of this invention.

[Drawing 4] It is drawing showing one example of the nozzle plate used for a recording head same as the above.

[Drawing 5] It is drawing showing the physical relationship of two adjoining record actuator units.

[Drawing 6] It is drawing showing other examples of this invention by relation between an actuator unit and a reservoir.

## [Description of Notations]

- 1 Actuator Unit
- 2 Passage Formation Unit
- 10 Spacer
- 11 12 Pressure generating room
- 13 Elastic Plate
- 14 15 Piezoelectric transducer
- 20 Ink Feed-Hopper Formation Board
- 21 Reservoir Formation Board
- 22 Nozzle Plate
- 23, 24, 27, 28 Nozzle run through-hole
- 25 26 Ink feed hopper
- 31-34 Reservoir
- 38-41 Ink inlet
- 42 43 Nozzle opening

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[Translation done.]

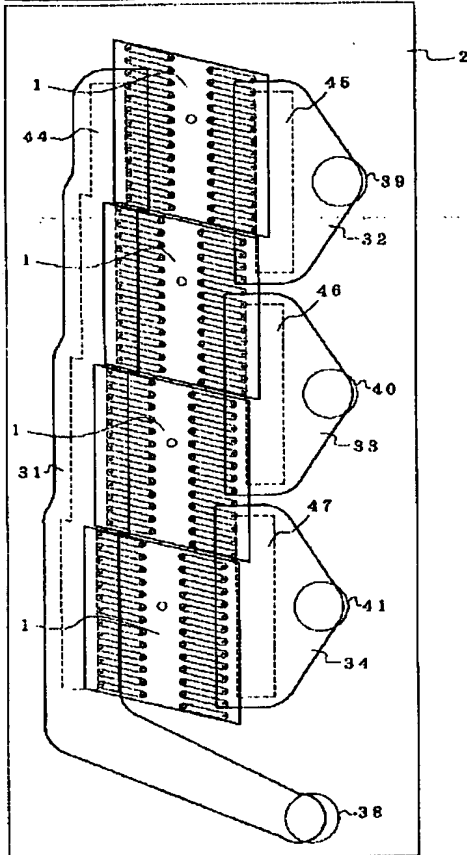
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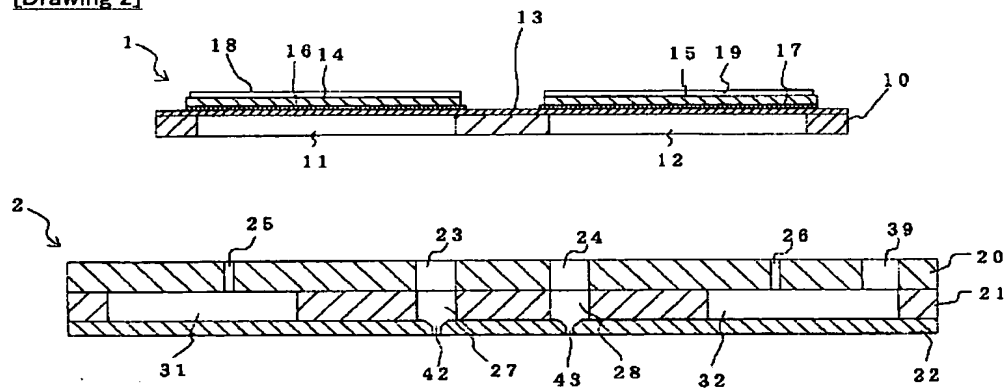
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## DRAWINGS

[Drawing 1]

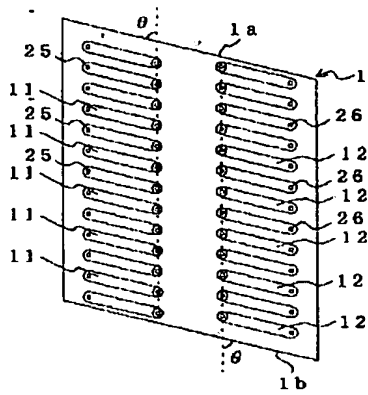


[Drawing 2]

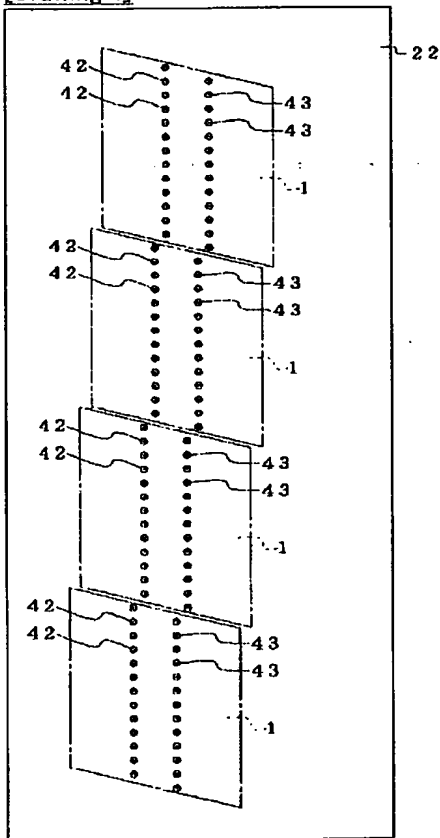


[Drawing 3]

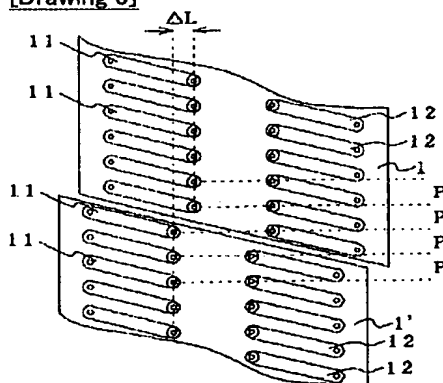




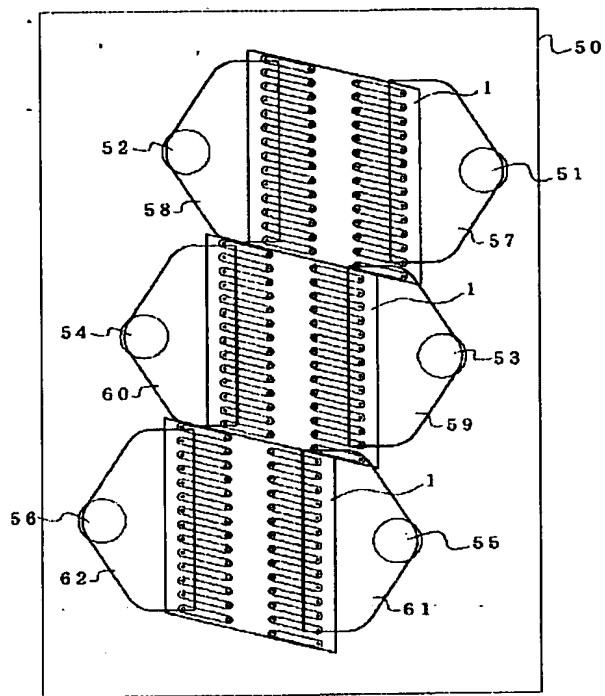
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]

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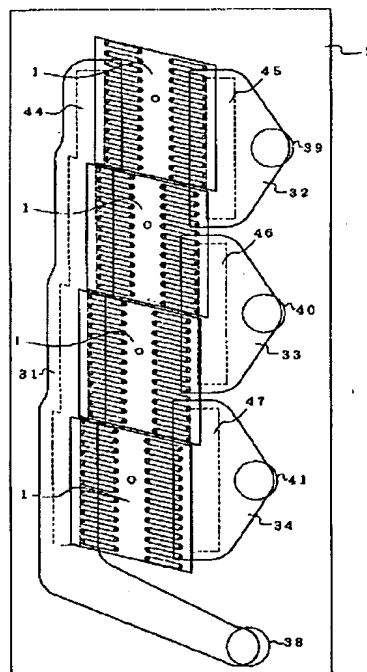
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(54) 【発明の名称】 インクジェット式記録ヘッド

(57) 【要約】

【課題】 複数のアクチュエータを可及的に少ないデッドスペースで配置して印刷精度の高い多数ノズルの記録ヘッドを構成すること。

【解決手段】 紙送り方向に並び、かつキャリッジの移動方向に2列形成された複数の圧力発生室と、各圧力発生室を加圧する圧力発生手段とを備えたアクチュエータユニット1、1と、一方の列に並ぶ圧力発生室に連通するリザーバ31と、他方の列に並ぶ圧力発生室を、紙送り方向に複数の領域に分割して連通する複数のリザーバ32〜34と、各圧力発生室に連通するノズル開口とを備えた流路形成ユニット2とを備え、アクチュエータユニットを可及的に小さなデッドスペースで配置し、比較的高速でデータ処理を行うことができる黒インク吐出用ノズル開口列数を、ノズル開口配列ピッチを乱すことなく、またブラックに比較してデータ処理が低速となるカラーインク吐出用のノズル開口列を、ブラックのノズル開口と高い精度で主走査方向の同一線上に配置する。



## 【特許請求の範囲】

【請求項1】 紙送り方向に並び、かつキャリッジの移動方向に2列形成された複数の圧力発生室と、前記各圧力発生室を加圧する圧力発生手段とを備えたアクチュエータユニットを、紙送り方向に複数配列し、少なくとも一方の列に並ぶ圧力発生室を、前記紙送り方向に複数の領域に分割して連通するリザーバと、前記各圧力発生室に連通するノズル開口とを備えた流路ユニットからなるインクジェット式記録ヘッド。

【請求項2】 前記一方の列に並ぶ圧力発生室には共通のリザーバが、また前記他方の列に並ぶ圧力発生室は前記紙送り方向に複数の領域に分割され、各領域の圧力発生室にそれぞれに独立した分割リザーバが連通する請求項1に記載のインクジェット式記録ヘッド。

【請求項3】 前記共通のリザーバにはブラックのインクが、また前記分割リザーバにはカラーインクが供給される請求項2に記載のインクジェット式記録ヘッド。

【請求項4】 前記2列のノズル開口列が、前記紙送り方向に同一線上に位置するように配列されている請求項1に記載のインクジェット式記録ヘッド。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術の分野】本発明は、ノズル開口に連通する圧力発生室の一部領域に圧力発生手段を設けて、圧力発生室のインクを加圧してインク滴を発生させるアクチュエータユニットを複数、縦列配置したインクジェット式記録ヘッド、より詳細には複数のアクチュエータユニットを組み合わせ構成したフルカラー印刷用のインクジェット式記録ヘッドに関する。

## 【0002】

【従来の技術】高速な印刷と高密度印刷に対応するために、1つの記録ヘッド当たりのノズル開口の数を増大させることが行われているが、インクジェット式記録ヘッドは、インクという液体を扱う関係上、ノズル開口や圧力発生室等の流路の流体抵抗等の不均一さの影響を敏感に受けるため、多数のノズル開口や圧力発生室を均一かつ高い精度で形成することが要求され、しかも流路や圧力発生手段の1つにでも不具合が発生すると、印字品質が極端に低下して記録ヘッドとしての用をなさなくなるため、その製造の歩留まりが極端に低いという問題を抱えている。

【0003】このような問題を解消するため、比較的圧力発生手段の数が少ない記録ヘッドをユニットとして複数個、主走査方向に並べて多数のノズル開口を備えた記録ヘッドを構成することが行われている。これによれば、1つのユニットを構成する圧力発生手段の数が少ない分だけユニットとしての製造の歩留まりが向上して、結果として多数のノズル開口を有する記録ヘッドを高い歩留まりで製造することができる。

## 【0004】

【発明が解決しようとする課題】しかしながら、各アクチュエータユニット間に間隙が生じるため、記録ヘッドとしてのサイズが大きくなり、その結果、記録装置の大型化を招いたり、また記録ヘッドを記録装置に取付ける際の微小な傾きによっても印字品質に大きく影響するブラック用のノズル開口と、カラー用のノズル開口との間のドット形成位置に大きな誤差が生じるため、組み付け作業が困難になるという問題がある。本発明はこのような問題に鑑みてなされたものであって、その目的とするところは特に複数の記録アクチュエータユニットを用いて小型で、かつノズル開口の位置精度を維持することができるインクジェット式記録ヘッドを提供することである。

## 【0005】

【課題を解決するための手段】このような問題を解消するために本発明においては、紙送り方向に並び、かつキャリッジの移動方向に2列形成された複数の圧力発生室と、前記各圧力発生室を加圧する圧力発生手段とを備えたアクチュエータユニットを、紙送り方向に複数配列し、少なくとも一方の列に並ぶ圧力発生室を、前記紙送り方向に複数の領域に分割して連通するリザーバと、前記各圧力発生室に連通するノズル開口とを備えた流路ユニットを備えるようにした。

## 【0006】

【作用】複数のアクチュエータユニットを紙送り方向に配置させ、またリザーバが紙送り方向に複数に分割されているため、ノズル開口数の割には記録ヘッドの主走査方向のサイズが小さくなり、記録装置が小型化する。また、異なるインクを吐出する圧力発生室を同一ユニットに形成することで高い位置精度を維持でき、また比較的高速でデータ処理を行うことができる黒インク吐出用ノズル開口列数を、ノズル開口配列ピッチを乱すことなく、またブラックに比較してデータ処理が低速となるカラーインク吐出用のノズル開口列がブラックのノズル開口と同程度に高い精度で主走査方向の同一線上に位置する。

## 【0007】

【発明の実施の形態】そこで以下に本発明の詳細を図示した実施例に基づいて説明する。図1は、本発明の一実施例を示すものであって、図中符号1、1、1、1は、同一構造として構成されたインクを加圧する4個のアクチュエータユニットを、相互に一定の距離 $\Delta L$ をずらせて後述する流路形成ユニット2に固定されている。

【0008】図2は、対向する圧力発生室の軸線の断面構造を、アクチュエータユニットと、流路形成ユニットとを分離して示すものであり、また図3は上述したアクチュエータユニットに形成されている圧力発生室の配列構造を示すものである。

【0009】図中符号10は、スぺーサで、深さ150 $\mu$ m程度の圧力発生室11、12を構成するの適した厚みを持つジルコニア(ZrO<sub>2</sub>)などのセラミックス板

からなる基板に、圧力発生室11、12がノズル開口42、43の配列方向線に対してその長手方向の軸線が鋭角 $\theta$ となり、かつ対向する内側の先端が主走査方向、つまりキャリッジの移動方向の同一線上に位置するように配列されて、インク滴の吐出タイミングをずらせることによりほぼ同一位置にドットの形成が可能のように構成されている。

【0010】また上下の外壁1a、1bは、圧力発生室11、12の軸線にほぼ平行となるように形成されその厚みが可及的に薄く構成されている。

【0011】このように圧力発生室11、12をその軸線方向がノズル開口の配列線に対して鋭角 $\theta$ となるように傾斜させて配列することにより、直角に配列した従来の圧力発生室に比較して、長く構成することができ、特に高密度化により圧力発生室の幅を小さくせねばならない場合にあっても、インク滴を吐出させるに必要な圧力発生室の容積を十分に確保することができる。

【0012】符号13は、弾性板で、スペーサ10と一体に焼成したときに十分な接合力を発揮するとともに、後述する圧電振動体14、15……のたわみ振動により弾性変形する材料、例えば厚さ7 $\mu$ mのジルコニアの薄板で構成されている。

【0013】14、15……はそれぞれ前述の圧電振動体で、弾性板13の表面に形成されている下電極16、17の表面に、圧電材料のグリーンシートを各圧力発生室11、12に対向させて貼付し、その後に焼結し、さらに表面に上電極18、19を作り付けて構成されている。

【0014】これら各部材10、13は、焼成により一体に固定されて前述のアクチュエータユニット1が構成されている。

【0015】一方、図中符号2は、これらアクチュエータユニット1の固定基板を兼ねる前述の流路形成ユニットで、スペーサ10の他方の開口面を封止するようにアクチュエータユニット1が貼着、固定される蓋板を兼ねるインク供給口形成基板20と、リザーバ形成基板21と、ノズルプレート22を積層して構成されている。

【0016】インク供給流路形成基板20は、厚さ100 $\mu$ mのジルコニアの薄板からなり、ノズルプレート22のノズル開口42、43と圧力発生室11、12とを接続する通孔23、24と、後述するリザーバ31、32(33、34)と圧力発生室11、12とを接続し、かつインク滴を吐出させることができる程度の流体抵抗を備えたインク供給口25、26とを穿設して構成されている。またリザーバ31、32(33、34)から離れた位置には、アクチュエータユニット1の側の同一線上に並ぶように一定のピッチで4つのインク導入口38~41が形成されている。

【0017】リザーバ形成基板21は、リザーバ31、32(33、34)を構成するに適した例えば150 $\mu$

mのステンレス鋼などの耐蝕性を備えた板材に、一側に配置される圧力発生室全体にインクを供給するリザーバ31と、各アクチュエータユニットの他側に位置する圧力発生室12に独立してインクを供給する3つのリザーバ32(33、34)を形成するとともに、各圧力発生室11、12とノズル開口42、43とを接続するノズル連通孔27、28を形成して構成されている。

【0018】他側に形成されたリザーバ32~34は、それぞれ4つのアクチュエータユニット1、1、1、1の他側に上下に並ぶ複数の圧力発生室12を3等分した個数、この実施例では13個の圧力発生室12に連通するインク供給口26と連通できるサイズに形成されている。また各リザーバ31~34は、インク供給口形成基板20に形成されたインク導入口38、39、40、41に連通され、リザーバ31には黒インク、また他のリザーバ32~34にはイエロ、マゼンタ、及びシアンのインクが供給可能になっている。

【0019】22は、前述のノズルプレートで、図5に示したようにアクチュエータユニット1、1、1、1にノズル連通孔23、27、及び24、28を介して連通し、かつ水平方向に並ぶ2つのものが同一線上に位置するように前述の圧力発生室11、12と同一のピッチで形成されている。なお、図中符号44~47は、各リザーバ31~34に形成された薄肉部からなるコンプライアンス付与領域を示す。

【0020】この実施例において、各ノズル開口42、43の配列線が副走査方向、つまり紙送り方向に一致するようにキャリッジに搭載して、流路形成ユニット2の側のリザーバ31にブラックのインクを、また他側の3つのリザーバ32、33、34にイエロ、シアン、マゼンタの各インクを供給する。そしてブラックのドット形成信号を各ユニット1、1、1、1の側の圧電振動子14に、またカラードット形成信号を各ユニットの他側の圧電振動子15に供給する。

【0021】すなわち、イエロのドット形成信号はリザーバ32に連通する圧力発生室12の圧電振動子15に、またマゼンタのドット形成信号はリザーバ33に連通する圧力発生室12の圧電振動子15に、さらにシアンのドット形成信号はリザーバ34に連通する圧力発生室12の圧電振動子15に供給する。

【0022】これにより、黒のドット形成信号が印加されると、圧電振動子14が圧力発生室側にたわみ変位して側の圧力発生室11のインクを加圧する。加圧された黒インクは流路形成ユニット2のノズル連通孔23、27を経由してノズル開口42からインク滴として吐出する。

【0023】駆動信号が断たれて圧電振動子14が元の状態に戻ると、圧力発生室11が膨張する。これにより当該圧力発生室11とインク供給口25を介して接続するリザーバ31からインクが圧力発生室11に流れ込

む。

【0024】またカラーのドット形成信号が印加されると、他側の圧電振動子15が圧力発生室側にたわみ変位して他側の圧力発生室12のインクを加圧する。加圧されたカラーのインクは流路形成ユニット2のノズル連通路24、28を経由してノズル開口43からインク滴として吐出する。

【0025】駆動信号が断たれて圧電振動子15が元の状態に戻ると、圧力発生室12が膨張する。これにより当該圧力発生室12とインク供給口26を介して接続するリザーバ32～34の色インクが圧力発生室12に流れ込む。

【0026】ところで、カラーのインク滴を吐出するノズル開口43は、紙送り方向にほぼ13ドット分ずつ位置がずれているので、記録用紙の送り量を各色の記録幅に一致させることにより、同一位置に各色のドットを形成することができる。以下、このようにな過程を繰返して印刷を実行する。

【0027】一方、テキストデータやモノクロ画像データを印刷する場合には、一側に上下に配列されている圧力発生室11の圧電振動子14にだけ駆動信号を供給すると、カラー印刷時の約3倍程度の紙送り方向の幅に印刷することができる。

【0028】なお、この実施例においては4個のアクチュエータユニットを用いて記録ヘッドを構成する場合に例を採って説明したが、圧力発生室の数が極めて多く形成されたものや、また2個以上のアクチュエータを用いたものに対しても、一側よりのものをブラックに、また他側側のものを複数の領域に分割して、各領域に独立してインクを供給することができる構造であれば同様の作用を奏することは明らかである。

【0029】図6は本発明の他の実施例を示すものであって、図中符号1、1、1は、同一構造として構成されたインクを加圧する3個のアクチュエータユニットを、望ましくは各ユニット1の2列の圧力発生室の列の内、一方の圧力発生室の列が隣接する他のユニットの圧力発生室の列の一方に紙送り方向で同一線上に位置するように、紙送り方向に一定距離ずらせて後述する流路ユニット50に配置されている。

【0030】流路ユニット50には、各アクチュエータユニットの圧力発生室と連通するノズル開口が、望ましくは各ユニット1に連通する2列のノズル開口列の内、一方のノズル開口列が隣接する他のユニットに連通するノズル開口列の一方に紙送り方向で同一線上に位置するように形成されている。また各アクチュエータユニット1、1、1の両側に位置するようにインク導入口51、52、53、54、55、56が形成され、各インク導入口51～56に連通させて各アクチュエータユニット1、1、1毎の圧力発生室に連通するリザーバ57、58、59、60、61、62が形成されている。

【0031】この実施例によれば、各インク導入口51～56には、色の異なるインク、つまりブラック、イエロ、濃マゼンタ、淡マゼンタ、濃シアン、淡シアンのインクを外部から供給することにより、6色のインクによるカラー印刷が可能な記録装置を、主走査方向のサイズを可能限り抑えて構成することができる。

【0032】なお、この実施例においてはアクチュエータユニットを3個使用する場合に例を採って説明したが、紙送り方向に配列するアクチュエータユニットの数をさらに増やすことにより、6色以上のインク滴を吐出させる記録ヘッドを構成することができる。

【0033】なお、上述の実施例においては、圧力発生室を圧電振動子のたわみ振動により膨張、収縮させるユニットを複数使用した記録ヘッドに例を採って説明したが、縦振動モードの圧電振動子の一端を弾性板に当接させたり、また圧力発生室を発熱素子により加熱して加圧するものに適用しても同様の作用を奏する。

【0034】また、上述の実施例においては圧力発生室をノズル開口の配列線に対して傾斜させたアクチュエータに例を採って説明したが、隣接領域でのノズル開口の配列ピッチを、アクチュエータユニット本来のノズル開口の配列ピッチと同一に維持できる構造のものにも適用できることは明らかである。

【0035】

【発明の効果】以上説明したように本発明においては、紙送り方向に並び、かつキャリッジの移動方向に2列形成された複数の圧力発生室と、各圧力発生室を加圧する圧力発生手段とを備えたアクチュエータユニットを、紙送り方向に複数配列し、少なくとも一方の列に並ぶ圧力発生室を、紙送り方向に複数の領域に分割して連通するリザーバと、各圧力発生室に連通するノズル開口とを備えた流路ユニットとにより記録ヘッドを構成したので、複数のアクチュエータユニットを可及的に小さなデッドスペースで配置できて、かつドット形成位置の精度を向上して印字品質の優れた小型の記録ヘッドを実現することができる。

【図面の簡単な説明】

【図1】本発明の記録ヘッドの一実施例を示す正面図である。

【図2】同上インクジェット式記録ヘッドを、対向する圧力発生室の軸線の断面構造を、アクチュエータユニットと、流路形成ユニットとを分離して示す図である。

【図3】本発明のインクジェット式記録ヘッドを構成するアクチュエータユニットの一実施例を、弾性板を取り外して示す図である。

【図4】同上記録ヘッドに使用するノズルプレートの一実施例を示す図である。

【図5】隣接する2つの記録アクチュエータユニットの位置関係を示す図である。

【図6】本発明の他の実施例を、アクチュエータユニッ

トとリザーバとの関係で示す図である。

【符号の説明】

1 アクチュエータユニット

2 流路形成ユニット

10 スペーサ

11、12 圧力発生室

13 弾性板

14、15 圧電振動子

20 インク供給口形成板

21 リザーバ形成板

22 ノズルプレート

23、24、27、28 ノズル連通孔

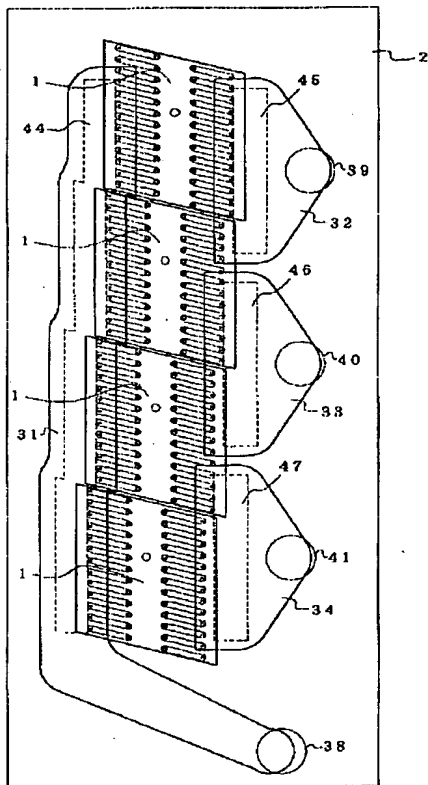
25、26 インク供給口

31～34 リザーバ

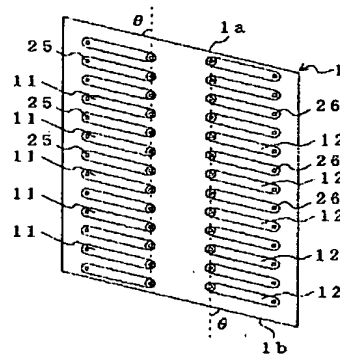
38～41 インク導入口

42、43 ノズル開口

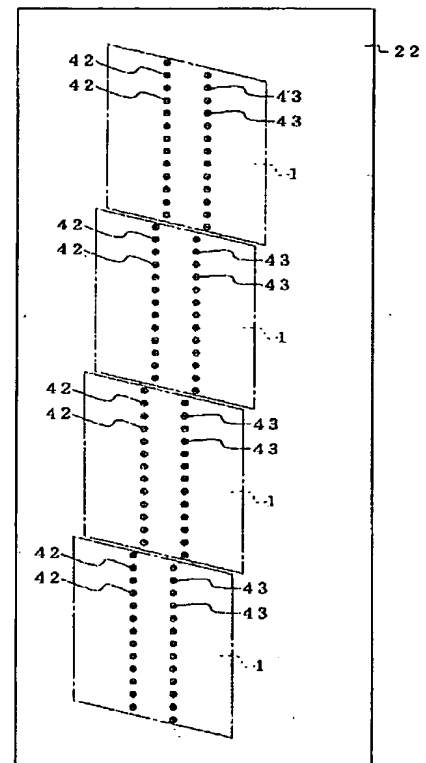
【図1】



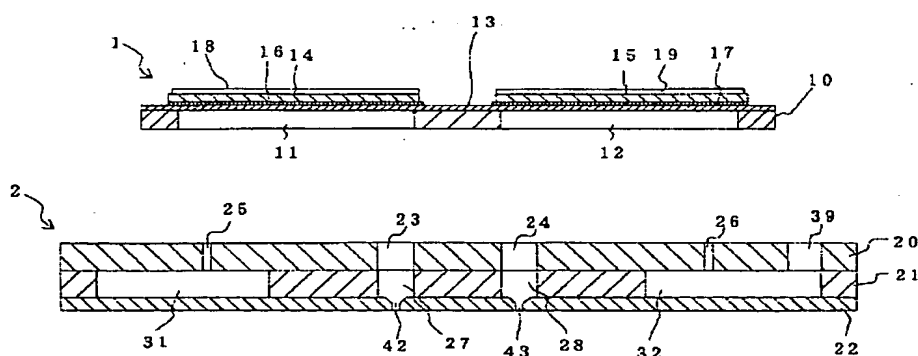
【図3】



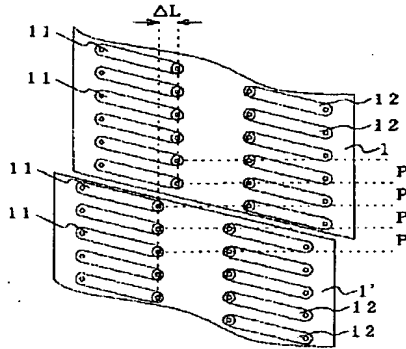
【図4】



【図2】



【図5】



【図6】

